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Original Article

Predictive value of microscopic hematuria in the diagnosis of intra-abdominal organ damage in blunt trauma

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Abstract

Introduction: Trauma is the most common cause of death under the age of 50, and one of the three main causes of death. The role of microscopic hematuria in the diagnosis of abdominal injuries is not clear. This study aimed to investigate the predictive role of microscopic hematuria in the assessment of abdominal organ damage in blunt trauma.

Methods: This cross-sectional study was conducted on all blunt trauma patients, who were admitted to the surgery department of Shahid Beheshti Hospital in Kashan in 2016 and 2017. Patients with blunt abdominal trauma aged 18 to 65 years were included, and patients with macroscopic hematuria, unstable hemodynamic status, and a history of kidney diseases were excluded. Spiral CT scan of the abdomen and pelvis was performed with intravenous injection of contrast material with delayed nephrogram phase as the gold standard. Data analysis was performed using the SPSS software. The Chi-square test, and McNemar's test were used. ($P<0.05$) was considered significant.

Results: In this study, 400 patients with blunt trauma participated. The frequency of microscopic hematuria in patients with intra-abdominal organ damage was significantly higher than in other patients (71.4% versus. 38.9%, $P<0.001$). The sensitivity and specificity of microscopic hematuria in diagnosing damage to intra-abdominal organs were 53.84% and 77.14%, respectively. The overall accuracy of the test was 62.0% (Kappa coefficient=0.22, $P<0.001$).

Conclusion: Due to the low accuracy of microscopic hematuria in diagnosing damage to intra-abdominal organs, it is not suitable as the main diagnostic method, but it can be used as an auxiliary method.

Keywords: Abdominal Injuries, Blunt Trauma, Evaluation, Hematuria

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Introduction

Trauma occurs as a result of energy exchange with the environment, which is higher than the body's ability to accept it. Trauma is the most common cause of death between the ages of 1 and 44 years and compared to cardiovascular diseases and cancers, it has more Years of Potential Life Lost (YPLL). Despite the spread of other health problems such as infectious diseases and malnutrition all over the world, currently, accidents are one of the most important problems in developing countries, and in recent years it has always been one of the three main causes of death (1). There are two types of traumas: penetrating trauma, due to the impact of sharp objects (such as bullets, knives, and sharp objects), and blunt trauma, which causes more energy to the surface of the body along with diffuse and multiple injuries (2). Abdominal blunt trauma is usually caused by motor vehicle collisions, recreational accidents, or falls. The most common injured organs in blunt abdominal trauma are the spleen, liver, retroperitoneum, small intestine, kidneys, bladder, colorectum, diaphragm, and pancreas. While the damage caused by most traumas is moderate injuries and requires surgical intervention only in some cases, the suspicion of the existence of such damages is the importance (3). The reason for the importance of this is the need for surgical intervention in severe injuries and the effectiveness of the intervention in the prognosis of patients. The most common warning signs in patients with non-penetrating abdominal trauma include pain, tenderness, gastrointestinal bleeding, hypovolemia, and evidence of peritonitis. Of course, in some cases, due to the accumulation of blood in the pelvic cavity, it may not be symptomatic (4-6). In the clinical examination, the symptoms of lap belt marks, wheel-shaped contusion, ecchymosis related to the flanks (Grey Turner sign) or navel (Cullen's sign), abdominal distension, crypt or instability of the lower chest and bruit auscultation can be seen. Deciding on how to manage trauma patients and performing diagnostic tests is very effective in their treatment and prognosis. Also, performing unnecessary diagnostic and treatment measures can cause financial and life losses (extra radiation in CT scan) and delay in effective interventions. Currently, radiography (abdomen-pelvis and chest), ultrasound and CT scan are three common methods to evaluate the injuries caused during blunt trauma (6-9). Ten percent of all deaths caused by trauma are due to injuries of abdominal organs (10, 11). According to the studies, one of the main reasons for the increase in the mortality rate due to blunt trauma is the delay in the correct diagnosis of the injuries (12). Also, incorrect assessment of the severity of abdominal injuries is the main cause of preventable deaths in abdominal trauma (13). The most important issue in the management of patients with blunt abdominal trauma is the quick and timely diagnosis of patients who need emergency surgical intervention. Based on a previous study, clinical examinations are not reliable for detecting possible injuries in blunt abdominal trauma (14).

Based on this, achieving a fast and accurate method to diagnose abdominal injuries caused by trauma is always one of the surgical challenges. One of the methods used to diagnose abdominal injuries is Diagnostic Peritoneal Lavage (DPL) (10, 15, 16). Despite the high sensitivity (96%), DPL is an invasive method and in 1% of cases it is associated with complications caused by damage to the bladder, intestines and large vessels (11, 17). Also, its low specificity causes unnecessary surgeries to be performed in 29-39% of cases (12, 18). Due to the invasiveness and low specificity of DPL, the use of computed tomography (CT) scan was suggested to diagnose abdominal injuries. Today, many studies have shown that sonography is a suitable alternative to DPL and CT scan methods (11, 16, 19-21). Today, in many European and Asian countries, ultrasound is used as the first line in examining patients with blunt abdominal trauma (15). However, based on the evidence, relying on sonography as the only diagnostic method may cause misdiagnosis (14, 22). In the emergency room, a Urine Analysis (UA) is performed to detect hematuria in cases of abdominal trauma.

This simple, quick and cheap test for detecting the presence of blood in urine or hematuria has a sensitivity of 91-100% (23, 24). According to the previous study, the presence of severe hematuria indicates intra-abdominal injuries. Of course, regarding microscopic hematuria, such an association with abdominal trauma cannot be considered (25). Today, there is a difference of opinion on the role of microscopic hematuria in the

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diagnosis of abdominal injuries and the prognosis of patients. According to a previous study, due to the low specificity and sensitivity of urinalysis and microscopic hematuria compared to the CT scan method, it is not recommended to use it to evaluate patients with non-penetrating abdominal trauma (26). Microscopic hematuria can be considered as a predictor of injury severity and intra-abdominal injuries (24). Due to the lack of sufficient studies and contradictory findings, this study was conducted with the aim of investigating the predictive role of microscopic hematuria in the assessment of blunt abdominal trauma.

Material and Methods

This cross-sectional study aimed to investigate the predictive role of microscopic hematuria in the evaluation of blunt abdominal trauma in all patients with blunt trauma who were hospitalized in the surgical department of Shahid Beheshti Hospital in Kashan, in 2016 and 2017. This study has been approved by the Ethics Committee of Kashan University of Medical Sciences (ethics code: IR.KAUMS.MEDNT.REC.1398.011). All patients with blunt abdominal trauma aged between 18 to 65 years included. The exclusion criteria were macroscopic hematuria, unstable hemodynamic status, and a history of kidney diseases. In this study, a vehicle-pedestrian crash, a motor vehicle crash with a speed change greater than 20 mile per hour (mph), being ejected from the vehicle during a crash, a motorcycle crash, a fall greater than 20 feet, or blunt direct trauma to the body were considered as blunt trauma. After obtaining written informed consent from the participants, demographic information including age, gender, and history of previous diseases such as diabetes, hypertension (HTN), dyslipidemia (DLP), cardiovascular diseases, kidney diseases, etc., were collected and registered. Based on the protocol at Shahid Beheshti Hospital in Kashan, simple abdominal imaging and Focused Assessment with Sonography in Trauma (FAST) were performed for patients with blunt trauma upon arrival. Other diagnostic and imaging procedures were performed by the physician and included repeating plain radiography 6 hours later, CT scan, or patient observation. Also, urinalysis was performed for all patients and microscopic hematuria (5 to 10 red blood cells in each visual field) was checked in patients. According to the general surgeon's opinion, a spiral CT scan of the abdomen and pelvis was performed with intravenous injection of contrast material at a speed of 2-2.5 cc per second with a delayed nephrogram phase. All the findings in the obtained graphs were reported and recorded by the radiologist. The damage to intra-abdominal organs was evaluated based on CT scan, and the diagnostic gold standard was also CT scan.

All data, including demographic information and paraclinical findings (CT scan report and urinalysis) , were entered into the statistical software IBM SPSS Statistics for Windows, version 22 (IBM Corp., Armonk, N.Y., USA). Data were described using central tendency indices (quantitative data with mean and standard deviation, and qualitative data with frequency and percentage). After checking the normality of quantitative data using the Kolmogorov-Smirnov test, appropriate parametric tests were used. The chi-square test was used. Also, indicators of diagnostic value and efficiency of microscopic hematuria were evaluated using McNemar's test. The significance level in this study was considered P-value<0.05.

Results

In this study, 400 patients with blunt trauma were enrolled, of which 297 (74.2%) were men and 103 (25.8%) were women. The mean age of the patients was 35.14 ± 8.99 years (18 to 65 years). Also, 46 (11.5%) patients had a comorbidity. According to Table 1, the mechanism of trauma in 276 (69%) were due to a motor vehicle accident, 79 (19.8%) were due to a fall, and 45 (11.2%) were due to other cases (conflict, sports events, etc.). Thirty-six (9%) patients had shock and 6 (1.5%) patients died. Out of 400 patients who were studied, 84 (21%) had damage to internal organs, including 44 (52.4%) had spleen damage, 29 (34.5%) had liver injuries and 11 (13.1%) had damage to other organs. Also, microscopic hematuria was present in 183 (45.3%) patients. The frequency of microscopic hematuria was significantly higher in patients with intra-abdominal organ damage (71.4% vs. 38.9%, P<0.001). Classification of patients based on age, gender, and hospitalization duration (less

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than and more than 7 days), shock, and mechanism of trauma (including accidents and falls) showed that the frequency of microscopic hematuria was significantly higher in patients with intra-abdominal organ damage (P<0.05). Also, the sensitivity and specificity of microscopic hematuria in detecting inter-abdominal organ damage were 53.84% and 77.14%, respectively. Also, its positive and negative predictive values were 81.39% and 47.37%, respectively. The overall accuracy of the test was 62% (kappa equal was 0.22, P<0.001).

Table 1. Comparison of the frequency of microscopic hematuria in intra-abdominal organ damage in different subgroups

Variables	Subgroups	Microscopic of hematuria	Organ damage		Total	P-value*
			No	Yes		
Age	<40	Yes	103 (40.4)	47 (68.1)	150 (46.3)	<0.001
		No	152 (59.6)	22 (31.9)	174 (53.7)	
	>40	Yes	20 (32.8)	13 (86.7)	33 (43.4)	<0.001
		No	41 (67.2)	2 (13.3)	43 (56.6)	
Sex	Male	Yes	93 (38.9)	39 (67.2)	132 (44.4)	<0.001
		No	146 (61.1)	19 (32.8)	165 (55.6)	
	Female	Yes	30 (39.0)	21 (80.8)	51 (49.5)	<0.001
		No	47 (61.0)	5 (19.2)	52 (50.5)	
Mechanism of trauma	Accident	Yes	84 (39.4)	45 (71.4)	129 (46.7)	<0.001
		No	129 (60.6)	18 (28.6)	147 (53.3)	
	Falling	Yes	26 (38.8)	9 (75.0)	35 (44.3)	0.028
		No	41 (61.2)	3 (25.0)	44 (55.7)	
	Others	Yes	13 (36.1)	6 (66.7)	19 (42.2)	0.137
		No	23 (63.9)	3 (33.3)	26 (57.8)	
Shock	Yes	Yes	10 (47.6)	9 (60.0)	19 (52.8)	0.463
		No	11 (52.4)	6 (40.0)	17 (47.2)	
	No	Yes	113 (38.3)	51 (73.9)	164 (45.1)	<0.001
		No	182 (61.7)	18 (26.1)	200 (54.9)	
Hospitalization length	<7 days	Yes	96 (40.9)	33 (78.6)	129 (46.6)	<0.001
		No	139 (59.1)	9 (21.4)	148 (53.4)	
	>7 days	Yes	27 (33.3)	27 (64.3)	54 (43.9)	<0.001
		No	54 (66.7)	15 (35.7)	69 (56.1)	
Total		Yes	123 (38.9)	60 (71.4)	183 (45.8)	<0.001
		No	193 (61.1)	24 (28.6)	217 (54.2)	

*Chi-square test were used.

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Discussion

The present study was conducted to determine the predictive value of microscopic hematuria in the diagnosis of intra-abdominal organ damage in blunt trauma. The etiology of trauma in most of the patients was motor vehicle accidents. In this study, most of the patients were men and mean age of patients was between 30-40 years. Based on the results, microscopic hematuria had a significant association with intra-abdominal organ damage in abdominal blunt trauma. Also, the results showed that the evaluation of microscopic hematuria in order to predict the damage of intra-abdominal organs had a high specificity and positive predictive value (PPV), but it did not have a favorable sensitivity and negative predictive value (NPV). Therefore, the use of microscopic hematuria to assess the damage of intra-abdominal organs is not suitable and cannot perform as a proper screening. However, in the presence of microscopic hematuria, damage to the intra-abdominal organs is more reliably suggested.

In a multicenter retrospective study, it was found that the microscopic hematuria evaluation does not have a suitable diagnostic value. However, unlike the present study, the sensitivity and NPV were more than the specificity and PPV. One of the possible reasons for this difference could be due to the microscopic hematuria measurement methods. In the aforementioned study, dipstick test was used and in the present study, urinalysis was used as a microscopic hematuria examination method (26).

An animal study showed that there is a significant association between microscopic hematuria and injury severity, but there is no association with histopathological damage. Also, the study showed that microscopic hematuria was related to the macroscopic findings of laparotomy. Therefore, microscopic hematuria can have a suitable diagnostic power to assess intra-abdominal damage, which is not consistent with the present study, and the reason for this could be the difference in the gold standard for examining intra-abdominal organ damage with macroscopic laparotomy and CT scan, respectively (24).

In two similar studies on children under 16 years of age with blunt trauma, it was also shown that microscopic hematuria has high specificity and very low sensitivity for evaluating intra-abdominal organ damage, so it cannot be used as a suitable diagnostic test. This finding was consistent with our study (27, 28).

In a study that was conducted with the aim of determining the predictive role of hematuria (gross and microscopic) in renal and genitourinary system damage in blunt abdominal trauma, it was shown that hematuria has a very high sensitivity and negative predictive value. Based on this, it can be concluded that hematuria is a suitable diagnostic test to evaluate the damage of the urinary-genital system and no other intra-abdominal organs (27). Of course, considering that the difference between gross and microscopic hematuria was not considered in the mentioned study, it is not possible to make a decision about microscopic hematuria with certainty.

In another study in children, it was found that the presence of microscopic hematuria is associated with a higher risk of intra-abdominal organ damage, multiple trauma, and kidney damage. Also, microscopic hematuria in the presence of other clinical signs and symptoms can indicate intra-abdominal damage. Based on this, the mentioned study suggests that a diagnostic CT scan should be performed in patients with blunt abdominal trauma with microscopic hematuria (29).

According to the type of study, the essential limitations of cross-sectional studies could be predicted for this study. Due to the limited budget and duration of the study, it was not possible to follow-up the patients after discharge from the hospital and evaluate the complications of abdominal organ damage in each of the groups.

Conclusion

The present study showed that microscopic hematuria can be used as an auxiliary test to confirm intra-abdominal organ damage due to its characteristics and high PPV, but due to its sensitivity and NPV, it is not reliable for organ damage screening. In other words, a negative microscopic hematuria test is not a reason for the absence of

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intra-abdominal injury, but its positive result greatly increases the possibility of intra-abdominal injury. Therefore, it is recommended to use microscopic hematuria as an auxiliary method along with CT scan, but not to replace it.

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Conflicts of interest

The authors have no conflicts of interest. Authors also indicate that they did not have a financial relationship with the organization that sponsored the research and had full control of all primary data and agree to allow the journal to review their data if requested.

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